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THE COCCIDAE ATTACKING THE TEA PLANT IN INDIA AND CEYLON

BY

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AGRICULTURAL RESEARCH INSTITUTE, PUSA

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I.—INTRODUCTION.

The present paper is designed to bring together the scattered information regarding the scale-insects attacking the tea plant in India and Ceylon, and especially to give a formal description of several new species occurring in India which have been discovered during the investigations of which it is the outcome.

As shown in the following list, the tea-plant in India and Ceylon is infested by a considerable number of scale-insects. Fortunately, very few of them are of serious consequence at present. But with Coccidæ—even more than with other phytophagous insects—every species must be regarded as a potential enemy, and treated accordingly. A species that for years may have existed only in small numbers, may suddenly, through some unforeseen and unrecognized change in its conditions and environment, multiply to a really dangerous extent.

Of all insect pests, members of this family are perhaps the most difficult to control. They are mostly small and inconspicuous and so escape notice until they have become firmly established. They increase very rapidly, many of them parthenogenetically.

The minute larvæ can subsist without food for considerable periods and may be unconsciously transported for long distances upon clothing or in the hair of animals and feathers of birds. They can penetrate crevices in the bark and conceal themselves in the buds and beneath the scales of plants. In this manner they are frequently transported from one country to another upon living plants. Many species protect themselves with waterproof coverings and so resist the action of insecticides.

In a word, the Coccidæ, as a family, must be looked upon as one of the important groups, if not the most important group of insect-pests in tropical and semi-tropical countries, and well warrant the attention that is now being paid to them in all parts of the world.

II.—LIST OF COCCIDÆ AFFECTING THE TEA PLANT IN INDIA AND CEYLON.

1. ICERYA ÆGYPTIACA (Douglas).

   (*Crossotosoma ægyptiacum*, Dougl.). 'Ent. Mo. Mag.,' xxvi., p. 79 (1890).

   Ceylon.

2. ORTHEZIA INSIGNIS (Douglas).

   'Jn. Quekett Micr. Club,' p. 169 (1887).

   (*nacrea*, Buckton), 'Ind. Mus. Notes,' iii, p. 103 (1894); 'Ind. Mus. Notes,' iv, p. 25 (1896).

   'Pests and Blights of the Tea Plant,' 2nd ed., p. 310 (1903).

   Ceylon.

3. CEROCOCCUS FICOIDES (Green).

   'Ent. Mo. Mag.,' xxxv, p. 225 (1890).

   'Pests and Blights of the Tea Plant,' 2nd ed., p. 316 (1903).

   Duars.

4. DACTYLOPIUS CITRI (Risso).

'Essai Hist. Nat. des Oranges' (1813).

Ceylon.

5. DACTYLOPIUS THEÆCOLA (Green).

'Pests and Blights of the Tea Plant,' 2nd ed., p. 317 (1903).

Assam; Darjeeling.

6. TACHARDIA DECORELLA (Maskell).

'Trans. N. Z. Instit.,' xxx, p. 247 (1892).

'Pests and Blights of the Tea Plant,' 2nd ed., p. 317 (1903).

Assam; Darjeeling.

var. *theæ* (Green).

Assam; Darjeeling.

7. CERONEMA JAPONICA (Maskell).

'Trans. N. Z. Instit.,' xxx, p. 234 (1898).

'Ind. Mus. Notes,' v, No. 1., p. 11 (1900).

India (no locality given).

8. ERIOCHITON THEÆ (Green).

'Ind. Mus. Notes,' v, No. 1, p. 10 (1900).

'Pests and Blights of the Tea Plant,' 2nd ed., p. 310 (1903).

Darjeeling.

9. PULVINARIA PSIDII (Maskell).

'Trans. N. Z. Instit.,' xxv, p. 223 (1892).

'Pests and Blights of the Tea Plant,' 2nd ed., p. 310 (1903).

Nilgiris, India: Ceylon.

10. CEROPLASTES CERIFERUS (Anderson).

'Mon. Cocci ceriferi' (1791).

'Ind. Mus. Notes,' i, p. 189 (1890).

'Pests and Blights of the Tea Plant,' 2nd ed., p. 316 (1903).

Assam : Terai : Darjeeling : Cachar : Ceylon.

11. CEROPLASTES FLORIDENSIS (Comstock).

'Rep. U. S. Dep. Ag.,' 1880, p. 331 (1881).

'Pests and Blights of the Tea Plant,' 2nd ed., p. 316 (1903).

Assam : Darjeeling : Ceylon.

12. CEROPLASTES RUBENS (Mask).

'Trans. N. Z. Instit.,' xxv, p. 214, (1892).

[Erroneously attributed to C. Myricæ (Linn.)]

'Ind. Mus. Notes,' v, No. 1, p. 8 (1900).

'Pests and Blights of the Tea Plant,' 2nd ed., p. 314 (1903).

Assam.

13. LECANIUM DISCREPANS (Green).

'Cocc. Ceylon,' pt. iii, p. 204 (1904).

(= similans). 'Pests and Blights of the Tea Plant,' 2nd ed., p. 314 (1903).

Ceylon.

14. LECANIUM FORMICARII (Green).

'Ind. Mus. Notes,' iv, p. 10 (1896).

'Cocc. Ceylon,' pt. iii, p. 190 (1904).

'Pests and Blights of the Tea Plant,' 2nd ed., p. 314 (1903).

Ceylon.

15. Lecanium hemisphæricum (Targ.).

'Studii sul. cocc.,' p. 26 (1867).

'Ind. Mus. Notes,' iii, No. 4, p. 41 (1894).

'Pests and Blights of the Tea Plant,' 2nd ed., p. 313 (1903).

'Cocc., Ceylon,' pt. iii, p. 232 (1904).

Assam : Duars : Ceylon.

16. Lecanium nigrum (Nietner).

'Enemies of Coffee Tree,' p. 9 (1861).

'Ind. Mus. Notes,' i, p. 117 (1889), and iv, p. 9 (1896).

'Pests and Blights of the Tea Plant,' 2nd ed., p. 312 (1903).

'Cocc. Ceylon,' pt. iii, p. 229 (1904).

South India : Ceylon.

17. Lecanium viride (Green).

'Ent. Mo. Mag.,' xxv, p. 248 (1889).

'Ind. Mus. Notes,' i, pp. 49, 117 (1889); ii, p. 168 (1893); iii, No. 6, p. 18 (1894).

'Pests and Blights of the Tea Plant,' 2nd ed., p. 312 (1903).

'Cocc. Ceylon,' pt. iii, p. 199 (1904)

South India: Ceylon.

18. Lecanium Watti (Green).

'Ind. Mus. Notes,' v, p. 6 (1900).

'Pests and Blights of the Tea Plant,' 2nd ed., p. 314 (1903).

Sibsagar, Assam.

19. CHIONASPIS BICLAVIS (Comstock).

'2nd Rep. Dep. Ent. Corn Univ.,' p. 98 (1883).

'Ind. Mus. Notes,' iv, p. 2 (1896).

'Cocc. Ceylon,' pt. ii, p. 152 (1899).

'Pests and Blights of the Tea Plant,' 2nd ed., p. 309 (1903).

Ceylon.

20. CHIONASPIS MANNI (Green).

'Pests and Blights of the Tea Plant,' 2nd ed., p. 309 (1903).

Assam : Darjeeling : Kangra Valley.

21. HEMICHIONASPIS SEPARATA (Green).

'Ind. Mus. Notes,' v, No. 1, p. 5 (1900).

'Pests and Blights of the Tea Plant,' 2nd ed., p. 309 (1903.)

Darjeeling.

22. HEMICHIONASPIS THEÆ (Maskell).

'Ind. Mus. Notes,' ii, No. 1, p. 60 (1891) ; No. 6, p. 168 (1893) : iii, No. 1, p. 25 (1893); No. 4, p. 39 (1894) ; iv, p. 3 (1896).

'Cocc. Ceylon,' pt. ii, p. 113, (1899).

'Pests and Blights of the Tea Plant,' 2nd ed., p. 730 (1903).

Throughout the tea Districts of India : Ceylon.

23. DIASPIS PENTAGONA, var. *theæ* (Maskell).

'Trans. N. Z. Instit.,' xxvii, p. 389 (1896).

'Ind. Mus. Notes,' v, p. 12 (1900).

'Pests and Blights of the Tea Plant,' 2nd ed., p. 310 (1903).

India (no locality given).

24. Fiorinia fioriniæ (Targ.)

'Studii sul. Cocc.,' p. 14 (1867).

'Cocc. Ceylon,' pt. i, p. 94 (1896).

'Ind. Mus. Notes,' iv, p. 5 (1896).

'Pests and Blights of the Tea Plant,' 2nd ed., p. 307 (1903).

Ceylon.

25. Fiorinia theæ (Green).

'Ind. Mus. Notes,' v, p. 3 (1900).

'Pests and Blights of the Tea Plant,' 2nd ed., p. 306 (1903).

Assam; Kangra.

26. Aspidiotus camelliæ (Signoret).

'Ann. Soc. Ent. Fr.' (4), ix, p. 117 (1869).

'Cocc. Ceylon,' pt. i, p. 60 (1896).

'Ind. Mus. Notes,' iv, p. 4 (1896).

'Pests and Blights of the Tea Plant,' 2nd ed., p. 303 (1903).

Assam; Darjeeling; Southern India; Ceylon.

27. Aspidiotus cyanophylli (Signoret).

'Ann. Soc. Ent. Fr.' (4), ix, p. 119 (1869).

'Cocc. Ceylon,' pt. i, p. 51 (1896).

'Pests and Blights of the Tea Plant,' 2nd ed., p. 305 (1903).

Ceylon.

28. Aspidiotus destructor (Signoret).

'Ann. Soc. Etn. Fr.' (4), ix, p. 120 (1869).

'Ind. Mus. Notes,' ii, No. 6, p. 168 (1893); iii, No. 1, p. 66 (1893).

'Cocc. Ceylon,' pt. i, p. 49 (1896)—(wrongly attributed to *lataniæ*).

Ceylon.

29. ASPIDIOTUS DICTYOSPERMI (Morgan).

'Ent. Mo. Mag.,' xxv, p. 352 (1889).

'Pests and Blights of the Tea Plant,' 2nd ed., p. 305 (1903).

Kangra.

30. ASPIDIOTUS LATANIÆ (Signoret).

'Ann. Soc. Ent. Fr.,' ix, p. 124 (1869).

'Pests and Blights of the Tea Plant,' 2nd ed., p. 306 (1903)—(= *Cydoniæ*).

Ceylon.

31. ASPIDIOTUS THEÆ (Maskell).

'Ind. Mus. Notes,' ii, p. 59 (1891).

'Pests and Blights of the Tea Plant,' 2nd ed., p. 304 (1903).

Kangra.

(ASPIDIOTUS NERII—*see* 'Pests and Blights,' p. 306—is wrongly recorded from Ceylon).

III.—DESCRIPTIONS OF NEW SPECIES. (E. E. Green.)

The following species among the above are here formally described for the first time.

CHIONASPIS MANNI, spec. nov.

Female puparium (fig. 2), of irregular form; broadly dilated posteriorly; usually curved. Exuviæ at anterior extremity pro-

jecting beyond margin of scale : larval pellicle fulvous ; nymphal pellicle castaneous, more or less concealed beneath a thin coating of greyish secretion : pygidial margin with prominent median lobes (fig. 2). Secretionary area dead white, but usually discoloured by a superficial admixture of particles of bark and other foreign matter. Length, 2·30 to 2·80 mm. Breadth, 1·10 to 2·15 mm.

Male puparium (fig. 3), elongate, narrow ; not carinated ; smooth and closely felted, the ventral as dense as the dorsal area, the terminal third slightly depressed. Pellicle fulvous, attached by the anterior half of the larval pellicle ; the remaining portion more or less erect : (fig. 4). Length, 1·75 to 2 mm. Breadth about 0·60 mm.

Adult ♀ of normal form : narrowest in front, broadest across abdominal area. In the early adult ♀ (fig. 5), the pygidium occupies fully a third of the whole area : later the thoracic segments increase in size. Prothoracic segment with four conspicuous oval or circular scars (fig. 7), anterior spiracles with parastigmatic glands. Divisions of abdominal segments usually well defined. Dorsal pores very conspicuous both on pygidium and on hinder margin of abdominal segments, where they are unusually numerous (fig. 6). Besides the larger oval pores, there are some small circular pores on the anterior ventral margin of abdominal and prothoracic segments. There are numerous stout spiniform squames on the latero-ventral area of abdominal segments—only a few of them projecting beyond the margin. Pygidium rounded or obtusely pointed. Median lobes large, prominent, their bases confluent, the apices rounded, divergent ; occupying a shallow median cleft, projecting far beyond the margin (fig. 8). Free margin of median lobes (in early adult example) minutely serrate : in older examples smooth (fig. 9). Second lobes duplex, prominent, narrow, the inner lobule usually somewhat dilated. Other lobes obsolescent, represented only by small marginal more or less chitinized prominences, each supporting a large oval pore. Circumgenital glands in five groups with very numerous orifices. Anal orifice near base of pygidium. Examples from *Ficus* and *Solanum* (otherwise iden-

tical) have the median lobes less prominent (in varying degree). Length of fully matured examples averaging 1·00 mm.

On twigs and branches of the tea plant (Assam and Darjeeling. Coll. H. H. Mann), on *Ficus* sp. (Kangra valley), and *Solanum melongena* (Calcutta, Coll. I. H. Burkill). A remarkable phenomenon associated with this species is the production of irregular woody swellings surrounding the groups of scales (fig. 1). The swelling is not superficial but involves the deeper woody tissues of the plant. It is not noticeable where the scales are attached to succulent plants, such as *Solanum*. I have noticed a similar phenomenon with typical *Diaspis pentagona*, which induces hard woody swellings on stems of *Flacourtia*, but not upon more succulent plants which it may attack. Female puparia scattered: male puparia in dense erect clusters.

There may be some question as to the correct genus in which this species should be placed. It has characters intermediate between *Chionaspis* and *Diaspis*, with a suggestion of *Mytilaspis* in the uncarinated male puparia. The female puparium is distinctly chionaspiform, the pellicles being placed at, and extending beyond the extreme anterior margin. The form and disposition of the male puparia resemble very closely those of *Diaspis pentagona* (= *amygdali*), but show absolutely no trace of carination. The characters of the female pygidium—taken alone—are again remarkably similar to *D. pentagona*, but may be distinguished by the proportionately greater size and more rounded extremities of the median lobes (those of *D. pentagona* being irregularly conical and more coarsely dentate). The differences are still more marked on comparison of the nymphal pellicles, the median lobes of *Manni* being narrower and more widely divergent and the second lobes minute and almost obsolete (fig. 10); while in *D. pentagona* the second lobes are strongly developed and conspicuous. The elongate form of the female puparium, taken in conjunction with the total absence of carination in the male puparium would by the usual classification based solely upon the characters of the puparia necessitate the inclusion of the species in the genus *Mytilapsis:* but I feel convinced that it is really more nearly related to members of the *Chionapsis* group.

Fig. 1. Tea branch with ♂ and ♀ scales, natural size (showing swellings due to presence of the insects).
„ 2. ♀ puparium × 24.
„ 3. ♂ „ × 24.
„ 4. Part of cluster of ♂ puparia showing manner of attachment to branch, × 12.
„ 5. Early adult ♀ ventral view, × 45.
„ 6. Pygidium of ♀ × 150.
„ 7. Anterior extremity of adult ♀ showing thoracic scars, × 55.
„ 8. Pygidial margin of adult ♀ (from tea plant), × 380.
„ 9. „ „ „ („ Ficus), × 380.
„ 10. Nymphal pellicle of ♀ (from tea plant), × 55.

DACTYLOPIUS THEÆCOLA, spec. nov.

Adult female (as received in dry condition and detached from its support) more or less completely covered with white mealy secretion, the parts of the body where the covering has been rubbed off showing reddish brown.

After maceration and preparation for the microscope (fig. 11), the most characteristic features are the exceptionally stout legs and the series of prominent rounded tubercles at the posterior extremity of the body.

Antenna (fig. 12) normally 7-jointed: but the division between the 3rd and 4th joints is less strongly marked than the others, is sometimes very inconspicuous, and occasionally indicated only by a slight constriction (fig. 13). The antennal formula is very variable, but the 3rd and 4th joints are always subequal, and the 7th considerably longer than any of the others.

Legs (fig. 14) very stout, evidently adapted for a fossorial habit. Tibia and tarsus relatively short. These two joints, with the claw, together equal the length of the femur (without trochanter). Claw (fig. 15) stout and falcate, the tip with a well-marked laminate

carina on the outer edge. I can find no trace of digitules in any of my examples.

Extremity of abdomen with from 6 to 8 prominent rounded tubercles, bearing numerous short stout spines ; similar groups of small spines on the margins of all the other segments. There are two pairs of large and conspicuous oval glandular scars on the dorsum, one pair on the cephalothorax shortly in front of the anterior limbs ; the other pair at the junction of the penultimate and antepenultimate segments. Anal ring bearing 6 stout but inconspicuous hairs, and surrounded by a series of about 16 somewhat finer hairs. Derm, especially on the dorsal surface, closely but inconspicuously dotted with minute circular pores.

Length 1·50 to 2·60 mm. Breadth 1 to 2·30 mm.

On roots of tea plants. Assam and Darjeeling (India). Collected by Dr. H. H. Mann.

Fig. 11. Adult female, ventral view, × 50.
,, 12, 13. Antenna, × 250.
,, 14. Anterior leg, × 100.
,, 15. Claw, × 450.

Tachardia decorella,—var. theæ, n. var.

Tachardia decorella, Maskell. 'Trans. N. Z. Instit.,' xxv, p. 247 (1892).

Tachardia decorella, Maskell. 'Ind. Mus. Notes,' iv, No. 2, p. 58 (1896).

Differs from typical examples from Australia in the corrugations of the ♀ test being broken into more or less distinct rounded tubercles (fig. 16). These corrugations may extend to the margin, but usually stop short of it. Colour dull brown. Length 2·50 mm.

The ♂ puparium (fig. 17) is smoother than in type : without any trace of corrugation. Hinder extremity slightly elevated. Colour reddish. Length 1·50 mm. (It is doubtful if Maskell's figure of the ♂ puparium really represents that stage. It is more probably the larval test).

The ♀ insect (fig. 18) differs from the Australian type, chiefly in the larger size and greater distinctness of the pores in the marginal gland groups ; and in the form of the perforate plate on the stigmatic processes, which are equilaterally triangular in typical *decorella*, but elongately triangular in var. *theæ*.

Collected by Dr. H. H. Mann on tea plants in Darjeeling, February 1907. Also in Assam, December 1900.

I have not seen the Indian examples originally submitted to Maskell. But examples received from the Indian Museum (Coll. H. H. Mann, December 1900), are identical with those now under consideration. Examples received (through Mr. Burkill) from Cinchona Calisaya (Government Cinchona Plantation, Mungpoo, Darjeeling), appear to be of the typical form.

Fig. 16. *Tachardia decorella*, var. *theæ*, ♀ test dorsal aspect, × 15.

Fig. 17. *Tachardia decorella*, var. *theæ*, ♂ puparium, dorsal aspect, × 15.

Fig. 18. *Tachardia decorella*, var. *theæ*, ♀ insect, removed from test, dorsal aspect, × 35.

IV.—DISTRIBUTION AND RELATIVE IMPORTANCE OF SCALE-INSECTS ON TEA IN NORTHERN INDIA. (H. H. Mann.)

The scale-insects described or referred to above are of very different importance. So far as the Indian tea districts are concerned, it may be said that the damage done by any of them has never been really serious except in the high level districts of Darjeeling and Kangra. Elsewhere they have been looked upon as curiosities, and it has rarely been possible to find more than a few plants affected on any tea estate.

Undoubtedly the most widespread and common coccid on tea is *Hemichionaspis theæ*, whose white male scales are very conspicuous. It occurs everywhere in the Assam Valley where "China" or "Hybrid" bushes are grown, and more particularly where, in

pruning, a large number of the feebler and weaker shoots are left in the bushes. In the Darjeeling district, and more especially on the estates in the neighbourhood of Kurseong, it ranks as one of the commonest pests of the tea plant. This species is only, in our experience, found on the leaves of the plant, but while the male scales are almost exclusively on the upper surface, the female are found indiscriminately on the upper and lower surfaces. The latter, except where the pest is exceptionally serious, are much fewer in numbers than the former. In the early part of the year, after pruning (February to June), the amount of this pest is small, but with the advent of the monsoon, the numbers rapidly increase, until, by the end of October, blocks of tea are sometimes white with the male scales. Its presence has hitherto been usually neglected, and we are not aware of any case in which vigorous measures have been taken to deal with the pest. Usually the damage which it does is stated to be small, but accounts are on record of young plants in nurseries having been actually killed by this insect in the Darjeeling district. This, however, has very rarely occurred.

Equally widespread, but rarely appearing so prominently, are *Fiorinia theæ* and *Lecanium hemisphericum*. Both of these may be stated to be more frequently Assam or Duars than Darjeeling pests. The latter has been found, not uncommonly, on apparently very healthy tea on a number of estates in the Dibrugarh, North Lakhimpur, and Bishnath districts of Assam, and has been found in quantity on a *Duranta* hedge adjoining tea in the first-named district. It is always found, on the tea bush, in a sheltered part of the plant, generally on stems protected by a dense leafy covering, and can be most frequently seen in the latter part of the rainy season. It is more often found on the young woody twigs of the tea, less than one year old, but also on the underside of the leaves. The damage hitherto attributed to this insect has been small.

The only other one of the insects mentioned, whose distribution is at all general, is *Tachardia decorella*, either in the typical form, or in the new form described in the present paper. It is common in Darjeeling, being found in almost every corner of the district on isolated bushes, and is not infrequent in several of the

Assam districts. In the Bishnath district we have noticed it completely ruin a bush, the whole of the stems being covered with the scales, but such a case has always been an isolated one. It is always found on the stem of the plant, and indiscriminately on the young and old wood.

An instance of the sudden breaking out into prominence of a coccid which has been known for many years, is that of *Ceroplastes ceriferus* in Cachar. Hitherto, though we have collected it in Assam, Terai, and Darjeeling, it was looked upon as a curiosity. During the early part of 1907 it has appeared, however, in epidemic form on several gardens in Cachar, being found on large numbers of bushes over a considerable acreage. The insect was noticed particularly in February and March 1907, and occurred almost entirely on wood more than one year old.

In the Darjeeling district there are two other scale insects which do considerably more harm than any of the aforementioned, and are really serious tea pests. These are *Eriochiton theæ* and *Chionaspis Manni.*

Eriochiton theæ is the more obvious of these, owing to the constant association of a black fungus (*Capnodium Footii*) with it. It was first collected from Thurbo, an estate near the border of Nepal in 1897, but has now been found on tea in almost every valley in the Darjeeling district. It attacks isolated bushes on both sides of the leaves, on the young and on the old stems. It can hardly be seen before June, but during the rains grows with very great rapidity, until by October and November the stem on which it occurs is almost or entirely killed. Kerosene emulsion has been tried on this insect with little effect, but considerable success has attended the use of rosin soap-caustic soda mixture to the stems after the pruning is completed.

Chionaspis Manni, the other more serious coccid pest in Darjeeling, was found by one of the authors on a tea estate in the Balasun Valley in 1901. It has since been noticed in almost every valley in the district. According to observations made in 1906, when occurring in Darjeeling, it invariably occurs on isolated bushes containing old and non-yielding wood. Whether the hardness

and non-yielding character of the wood was the consequence of the presence of the insect, or only allowed the latter to obtain a start, could not be ascertained, but every case noted during September and October occurred on a bush which would have been marked for 'heavy-pruning' as a result of its condition at the time. It was never found on wood less than one year old, nor on bushes which had a good leafy cover, but usually on stems fully exposed to the sun. Most of the examples of this coccid were, however, found in north-eastern slopes. If this scale-insect can be held, as seems probable, to be the cause of the unyielding character of the bushes on which it occurs, its presence becomes very serious, though hitherto the isolated character of its attacks had prevented very general attention being drawn to it. No experiments have, hitherto, been made as to the best method of eradicating this pest.

A good deal of interest attaches to *Dactylopius theæcola*, one of the new species described in the present paper, owing to the fact of its being the only coccid attacking the roots of tea hitherto described, and to the present limited character of its distribution. It has only been recorded from two or three estates at an elevation of from 2,000 to 3,000 feet in the neighbourhood of Darjeeling, and attention was drawn to it by the fact of extreme activity of black ants in the neighbourhood of the bushes. On digging round the plants, which were some of the most vigorous and flourishing on the estate, it was found clinging to the bark of the root just under the surface of the ground. In a few cases, where soil had accumulated round the main branches of the bushes, it was found under the soil in these also. It is apparently active throughout the whole of the season when the soil is moist, but when the rain becomes heavy the insects descend lower in the ground, and have been found on some of the branch roots of the tea plant. Hitherto no appreciable damage has been done by this insect, which has been found only on 'high-class hybrid' or on 'Assam-indigenous' bushes, and the anxiety among planters which was felt in the matter on the first discovery of the insect has now completely died away.

The remainder of the scale-insects recorded in the above list as occurring in the Indian tea districts (with the exception of

Aspidiatus theæ from the Kangra Valley, of which we have no experience from the practical point of view) have been up to the present, only curiosities, and have not been frequently enough observed to make possible more than a passing notice of their occurrence on the tea plant in Northern India.

V.—DISTRIBUTION AND RELATIVE IMPORTANCE OF SCALE INSECTS ON TEA IN SOUTH INDIA AND CEYLON (E. E. Green).

In Southern India; *Aspidiotus camelliæ* Sign. has recently attracted attention as a tea pest. Examples received from an estate in Coonoor show that this species must be considered of importance. As noticed in Ceylon, this is more particularly a pest of young tea, up to the second or third year of growth. In the Coonoor specimens, the scales were massed upon the young stems and had practically killed the upper parts of the plant. Fresh healthy shoots were reported to be springing up from below the injured parts, but unless prompt remedial measures were undertaken, these new shoots would soon be infected. In the case of very young plants, wholesale removal and destruction by fire would be the only practicable treatment. With more advanced plants, collar pruning could be resorted to. It should be clearly understood that when once the plant is affected, it is a source of danger to its neighbours. The prunings should be destroyed on the spot. Removal to other parts of the field will almost certainly result in sowing the pest along the route of transport.

As regards tea in Ceylon, there have been one or two scares from the sudden appearance of *Orthezia insignis* on fields adjoining lantana scrub. Tea so affected is certainly warranted to cause alarm. This pest affects the young shoots of the plant and is found to be swarming even on the flush. It is fortunately a conspicuous insect and cannot well be overlooked. The several outbreaks that have occurred have always received prompt attention,

pruning and burning being the treatment adopted. At the same time the boundaries have been cut well back and fired. Such measures have invariably been successful in checking the pest and preventing its recurrence. It appears that *Orthezia* does not readily adopt a tea diet; but it is probable that—if left undisturbed on the tea, subsequent generations of the insect would soon accustom themselves to the change of food plant.

Pulvinaria psidii has sometimes occurred in considerable force on localized sheltered patches of tea. It is accompanied and rendered conspicuous by a copious growth of black fungus (species of *Meliola* and *Capnodes*) which covers the leaves as if with a shower of soot. The pest does not seem to spread to any extent and is largely kept in check by a dipterous insect that breeds in the ovisacs of the bug and destroys the eggs.

Lecanium formicarii is sometimes troublesome, chiefly on account of its attendant ant (*Cremastogaster dohrni*) which constructs brown-paper-like nests around the colonies. This ant is very pugnaceous and resents any disturbance of the bush in which it has set up its establishment. The destruction of the nests and the application of Macdougal's insecticide or kerosene emulsion to the infested branches has been found sufficient to keep the pest in check.

Lecanium hemisphæricum causes some injury to individual bushes, but usually confines its attacks to plants that are sheltered from rain by overhanging rocks.

Chionaspis biclavis is perhaps the most serious and widespread of all Coccidæ affecting the tea plant in Ceylon. It is the more dangerous because it is so seldom recognized, the scale being concealed by the incorporation of the natural fibres of the bark. Its presence may, however, be detected by the pimply appearance of the bark. After the death of the insect, the bark often becomes thickly encrusted by a dense velvety purplish fungus. Its attacks result in an unhealthy hidebound condition of the main stems and branches. The usual treatment consists of the excision of the worst affected stems, during pruning, and scrubbing the remainder with a pad of coir matting moistened with kerosene emulsion.

This species has not yet been recorded from India, but it may very possibly exist—unrecognized—in the southern districts.

Aspidiotus camelliæ is a pest of young tea plants, as in Southern India ; but does not give very much trouble in Ceylon, now that few new clearings are being opened.

PLATE XVI.

Fig 2.

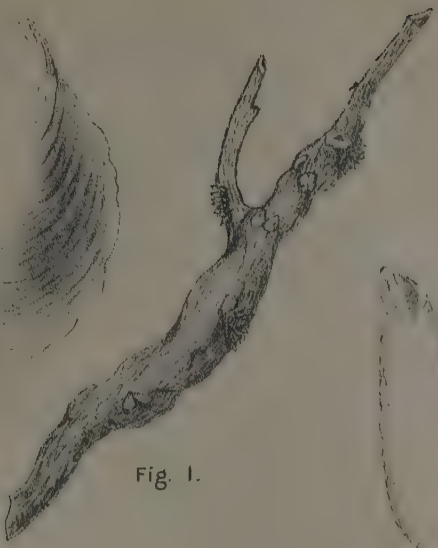

Fig. 1.

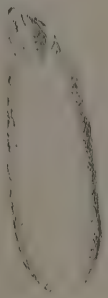

Fig. 3.

Fig. 4.

Fig. 5.

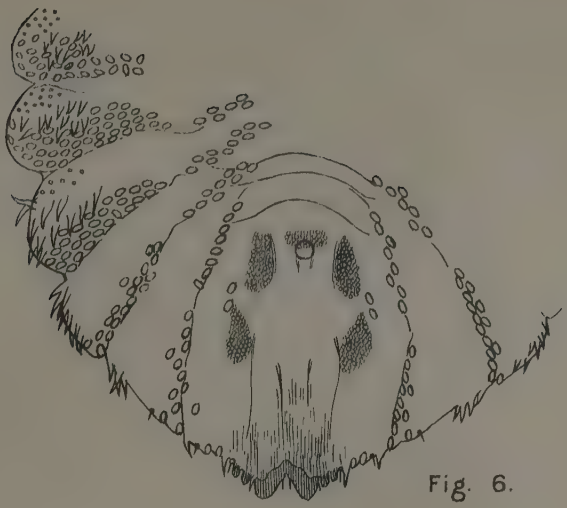

Fig. 6.

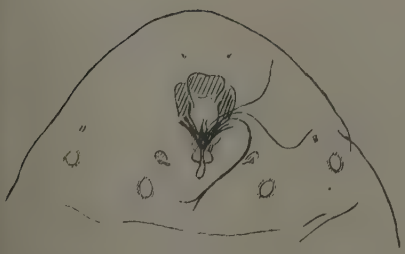

Fig. 7.

Fig. 8.

PLATE XVIII.

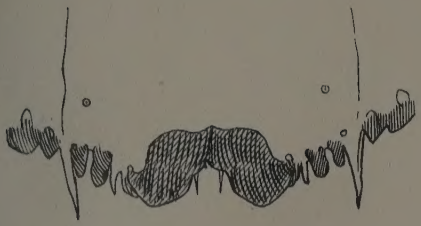

Fig. 9.

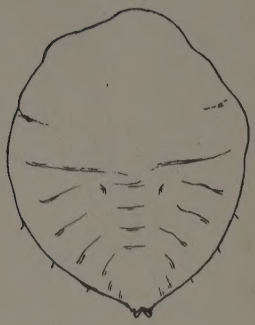

Fig. 10.

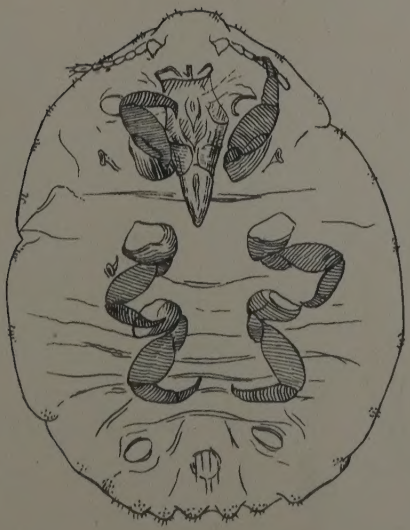

Fig 11.

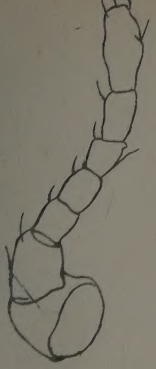

Fig. 12.

Fig. 13.

Fig 14.

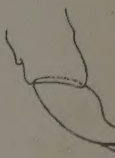

Fig. 15.

Fig. 16.

Fig. 17.

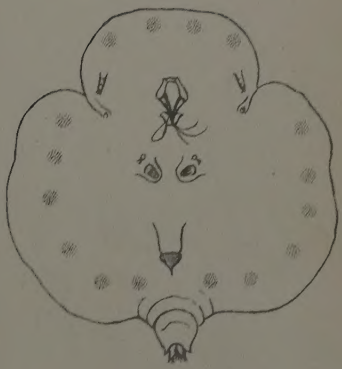

Fig. 18.